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The Effect of Levofloxacin and Moxifloxacin on the Structure and Phase Transition of the Lipid Bilayer

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The treatment of a wide range of infectious diseases requires the use of antibacterial drugs of the fluoroquinolone (FQ) group. These commercially available drugs have high activity, and have a wide spectrum of effect. One of the problems associated with the use of antibacterial drugs is the increasing resistance of bacteria to drugs due to a global lack of control over their consumption and disposal. However, recent studies have shown that resistance to FQ is developing slowly and these drugs are relevant and effective in the treatment of various infections.

In the current work to obtain liposome-based delivery systems Dipalmitoylphosphatidylcholine (DPPC), cardiolipin (CL) and cholesterol (Chol) were used. DPPC, CL and Chol are lipids that are essential for real biomembranes, therefore they do not cause an aggressive immune reaction. To develop stabilized liposomal systems, polycation glycol-chitosan (GlyChit) was used to form electrostatic complexes on the surface of the lipid bilayer with anionic groups [1]. The stability of these complexes is pH dependent, which affects the release processes of encapsulated drugs. GlyChit, being a biopolymer, also does not cause immune rejection and is biodegradable and allows regulation of the rigidity and stability of liposomes for delivery systems by changing complexation conditions. Moxifloxacin (Mox) — FQ of the fourth generation and levofloxacin (Lev) — FQ of the third generation, structurally differing by hydrophobic-hydrophilic substituents, were chosen as the studied antibacterial drugs. These differences, along with different ionization parameters, suggest that the effect of antibacterial drugs on the lipid bilayer will not be the same. The Mox's heterocycle can be protonated, which leads to ionic interaction with anionic liposomes and affects the state of the lipid bilayer. The interaction of Lev with liposomes has not been fully understood yet.

Phase transition curves were obtained by DSC and ATR-FTIR spectroscopy. The shift of the absorption band of CH_2as vibrations responds to the mobility of acyl chains, which allows conclusions to be drawn about the phase transition processes.

It is found that the temperature of the phase transition does not change with the addition of Lev, and the enthalpy decreases. Presumably, the electrostatic interaction with a microphase rich in CL contributes to the stabilization of the system, and hydrophobic interactions with DPPC lead to disordering of the bilayer and acceleration of the phase transition, and these effects almost neutralize each other. The electrostatic interaction of anionic liposomes with GlyChit prevented the formation of complexes with Lev due to competition for a negative charge of CL. A more complete understanding of the mechanism of Lev and Mox release from liposomes of different compositions can facilitate the process of selecting the structure of liposomal delivery systems with specified parameters in order to control the release of the encapsulated drug.

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